TOUCH DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 14/983,546 filed on Dec. 30, 2015, which claims the benefit of Republic of Korea Patent Application No. 10-2015-0015517 filed on Jan. 30, 2015, and also Republic of Korea Patent Application No. 10-2015-0143597 Oct. 14, 2015, all of which are hereby incorporated by reference as if fully set forth herein.

BACKGROUND

[0002] Field of the Invention

[0003] The present invention relates to a touch sensitive apparatus which decreases a load of each of a plurality of touch electrodes and reduces a load deviation between the plurality of touch electrodes, thereby enhancing image quality.

[0004] Discussion of the Related Art

[0005] Instead of an input device such as a mouse, a keyboard, or the like which is conventionally applied as an input device of a liquid crystal display (LCD) apparatus, flat panel display apparatuses, a touch panel that enables a user to directly input information with a finger or a pen is applied to LCD apparatuses. Since all users can easily manipulate the touch screen, the application of the touch panel is being expanded.

[0006] Touch panels are categorized into a resistive type, a capacitance type, an infrared type, etc. depending on a touch sensing method. Recently, since the capacitance type provides convenience in a manufacturing process and is good in touch sensitivity, the capacitance type is attracting much attention. Capacitive touch panels are categorized into a mutual capacitance type and a self-capacitance type.

[0007] Recently, an in-cell touch type panel where a capacitive touch sensor is built into a liquid crystal panel has been developed for slimming LCD apparatuses to which a touch screen is applied. In-cell touch sensitive apparatuses use a common electrode, which is disposed on a thin film transistor (TFT) array substrate, as a touch sensor. In the following description, a touch sensitive panel denotes that a touch sensor is built into a liquid crystal panel in the in-cell touch type. Also, sensing of touch electrodes is performed in the self-capacitance type.

[0008] FIG. **1** is a diagram schematically illustrating a related art in-cell touch type touch sensitive apparatus, and FIG. **2** is a diagram illustrating a connection structure between a self-capacitive touch electrode and a touch signal line.

[0009] Referring to FIGS. **1** and **2**, the related art in-cell touch type touch sensitive apparatus includes a touch sensitive panel, a touch driver **30**, a display driver (not shown), and a backlight unit (not shown).

[0010] The touch sensitive panel includes a TFT array substrate and a color filter array substrate which are bonded to each other with a liquid crystal layer therebetween. A common electrode disposed on the TFT array substrate is patterned as a plurality of blocks, and thus, a plurality of touch electrodes **10** are provided. In FIG. **1**, it is illustrated as an example that twenty touch electrodes **10** are disposed in a horizontal direction, and thirty touch electrodes **10** are disposed in a vertical direction in the touch sensitive panel, namely, a total of 600 touch electrodes **10** are disposed in the touch sensitive panel.

[0011] The related art in-cell touch type touch sensitive apparatus divides one frame period into a display period and a touch period and performs display driving and touch driving in a time division method.

[0012] During the display period, the related art in-cell touch type touch sensitive apparatus supplies a data voltage to a pixel electrode and supplies a common voltage (Vcom) to the plurality of touch electrodes **10**, thereby displaying an image. During the touch period, the related art in-cell touch type touch sensitive apparatus supplies a touch driving signal to each of the plurality of touch electrodes **10** and then senses a capacitance of each of the plurality of touch electrodes **10**, thereby determining whether there is a touch and detecting a touched position.

[0013] The touch driver **30** includes a touch signal generator, a sensing unit, and a plurality of multiplexers **32**.

[0014] The plurality of multiplexers **32** are for decreasing the number of channels of the touch driver **30**, and the plurality of multiplexers **32** having an input-to-output ratio of N:1 are disposed. Each of the plurality of touch electrodes **10** is connected to one touch signal line **20**, which is connected to a channel of a corresponding multiplexer **32**.

[0015] As illustrated in FIG. **2**, a first touch electrode **12***a* is connected to a first touch signal line **22***a* through a plurality of contacts CNT. Also, a second touch electrode **12***b* is connected to a second touch signal line **22***b* through a plurality of contacts CNT. As described above, each of the plurality of touch electrodes is connected to a corresponding touch signal line through a plurality of contacts CNT.

[0016] The touch driving signal output from the touch signal generator is supplied to each of the plurality of touch electrodes **10** via a corresponding multiplexer **32**. Also, the sensing unit senses the amount of electric charge charged into each of the touch electrodes **10** to determine whether there is a touch and detect a touched position.

[0017] FIG. **3** is a diagram illustrating a problem where image quality is degraded due to a load deviation of a touch electrode.

[0018] Referring to FIG. **3**, the touch driving signal is applied to the touch electrode **12***a* through the touch signal line **22***a*, but a load deviation occurs in one touch electrode. Also, a load deviation occurs between a plurality of touch electrodes. For this reason, image quality is degraded.

[0019] For example, when twenty touch electrodes are arranged in a vertical direction, a load deviation occurs between a first electrode **12***a*, a tenth touch electrode **12***b*, and a twentieth touch electrode **12***c*. That is, when a touch electrode is close to a contact CNT that connects the touch electrode and a corresponding touch signal line, a load of the touch electrode is small, but as a touch electrode becomes farther away from a contact CNT that connects the touch electrode and a corresponding touch signal line, a load of the touch electrode increases.

[0020] When a load deviation occurs in one touch electrode and between a plurality of touch electrodes, a difference occurs in a time taken until the common electrode (Vcom) ripples and then returns to an original voltage value, and due to such a time difference, a difference of root mean square (RMS) values of voltages between regions occurs in a whole screen. For this reason, image quality is degraded.